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ABSTRACT

The use of telecommunications technologies has been encouraged to improve quality and reduce costs of human services delivery; however, the adoption rate has been disappointing. This paper reviews the model found most useful for the analysis of barriers to the adoption of telecommunications technologies. Characteristics which have been found to be related to the degree of innovation adoption are: (1) status of knowledge and engineering; (2) value attributes; (3) trialability; (4) complexity; (5) communicability; (6) regulation; and (7) autonomy of operation. Relevance, compatability, and relative advantage are examined as characteristics of application which influence the innovation process. Results show that: (1) radio and telephone have the least number of barriers; (2) there are many barriers to cable television use, including technical and distribution problems; (3) time, cost and need to aggregate demand limit autonomy of operations; and (4) regulation and the complexity of telecommunications technologies are barriers to adoption. Trends which may lead to breaking these barriers are indicated. A bibliography is attached. KP)

THE FUTURE OF TELECOMMUNICATIONS TECHNOLOGIES FOR THE DELIVERY OF HUMAN SERVICES[1]

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Introduction

For almost ten years, the Department of Health, Education, and Welfare has been encouraging the use of telecommunications technologies as a way of improving the quality and reducing the costs of human services delivery. Demonstration projects have been funded utilizing such technologies as video tape recorders, broadcast television (both commericial and public), cable television, innovative telephone services, teletype, computers, and more recently, satellites, in the fields of medicine, vocational rehabilitation, and education. An extensive body of literature has been compiled describing these experiments, and considerable enthusiasm has been expressed about the potential of telecommunications technologies to improve human services delivery. The record of adoption has been disappointing.

It is not entirely clear just why this spotty adoption record exists. Many hypotheses can be posed, including the relative immaturity of the technology, the need for technicians and engineers to assist practitioners in the operation of the system, the inability to quantify benefits accruing from the use of the technology, the high costs associated with the technology, and the inappropriate matching of technology to needs, i.e., a solution looking for a problem. In addition, there are attitudinal obstacles. Human service practitioners find it difficult to adopt practices

that run counter to their training, even if those practices have promise for improving their effectiveness.

Under a grant from the Rehabilitation Services Administration (RSA) of DHEW, research is underway to assess the barriers to the utilization of telecommunication adoption by State Vocational Rehabilitation agencies. RSA's interest in telecommunications stems from the Rehabilitation Act of 1974, which stresses the importance of utilizing new technology as a way of increasing the level of services for the same dollar or decreasing the cost of present services to the vocationally handicapped. Further, the Act requires that priority be given to the severely disabled.

As a result, funding has been made available to RSA to experiment with new technologies and, in particular, telecommunications technologies. Telecommunications appears attractive for meeting the priority needs of rehabiliation agencies, i.e., servicing the severely disabled and training the rehabilitation staff. Often trapped in the home and unable to move freely, the severely disabled can, via a telecommunications link, learn a skill and perform in a useful renumerative job, such as, computer programming from the home via computer- communication links. This additional emphasis on the severely disabled has increased the need for informing rehabilitation personnel of new service techniques, which could be accomplished via telecommunications, e.g., television networks or video tapes.

The field of vocational rehabilitation as a target for the examination of barriers to innovation is an especially rich one. There are few human services delivery agencies where innovations are adopted with such rapidity and flexibility as the VR agencies. Artifical limbs and organs, innovative designs for chairs, furniture and other devices are relatively easy and quickly adopted. Recently, a national program to reduce architectural barriers to the disabled has been implemented, and in every city there are curbs being designed into ramps.

Yet, despite efforts to introduce the telecommunications technologies, little progress is apparent except for a handful of unique application. The Talking Book for the Blind, now delivered by special radio frequencies, and the increasing use of captioned television for the hearing-disabled are two primary examples of recently adopted innovations.

While this research has been focused on barriers to the adoption of the telecommunications technologies in the Vocational Rehabilitation field, findings more widely relevant to the adoption of telecommunications are emerging. The purpose of this paper -- a report of research progress -- is to review the model found most useful for the analysis of the barriers to the adoption of telecommunications technologies, independent of application. Several significant findings are given, which we believe are relevant to the broader issue of overcoming barriers to the adoption, generally, of the telecommunications technologies.

FRAMEWORK for ANALYSIS

The barriers to the adoption of telecommunications technology for the delivery of human services may best be viewed from the perspective of innovation theory. Traditionally, innovation has been defined as "the first or early use of an idea by one of a set of organizations with similar goals" (Becker and Whisler, 1967). However, this narrow definition does not provide an effective framework for this analysis, because (1) many of the telecommunications technologies have been available for several years, (2) a variety of social applications have been broadly discussed (e.g., in the Sloan Commission Report, 1971), and (3) a diversity of demonstrations have been undertaken.

A more appropriate approach is to assume the broader definition of Zaltman et al. (1973), who describe an innovation as "any idea, practice, or material artifact perceived to be new by the relevant unit of adoption" (p. 10). The fact that a similar application had been demonstrated elsewhere does not detract from its perceived "newness" and impact upon the operation of a potential adopting unit. "If the idea seems new and different to the individual (or organization), it is an innovation" (Rogers and Shoemaker, 1971, p. 19).

The adoption of an innovation is more complex than an "all-or-nothing event", although many studies have treated it in this dichotomous manner (Calsyn, Tornatzky and Dittmar, 1976). Innovation is a stepwise process of increasing committment over time by the adopting unit. This process is neither

unidirectional nor inevitable. As an innovation progresses through the stages of testing, installation (connecting the innovation to the ongoing structure of activities of the organization), and institutionalization (identifying the innovation as an integral element of the organization's operations), many obstacles are confronted which require decisions of continuation, regression, or rejection.

We view adoption as a continuum, varying along dimensions of operational and financial incorporation, within a specified period. Operational incorporation refers to the degree by which an innovation has been absorbed into the operation of the organization, while financial incorporation refers to the degree to which the adopting unit has assumed full financial responsibility for the operation of the innovation. Both of these dimensions are weighted according to the amount of time during which the unit has been in the adoption process.

This project is attempting to analyze this process and identify the barriers to the adoption of telecommunications by means of a rather simple conceptual framework (as illustrated in Figure 1). The operational needs within a human service agency may be matched with technological delivery possibilities which could create an opportunity for an innovative application. Implementation of this application within an organization requires an agent of change to serve as a catalyst in a conducive organizational setting.

This framework hypothesizes that adoption is mediated by the attributes of these five elements. As summarized in such

BARRIERS TO ADOPTION OF TELECOMMUNICATIONS TECHNOLOGIES

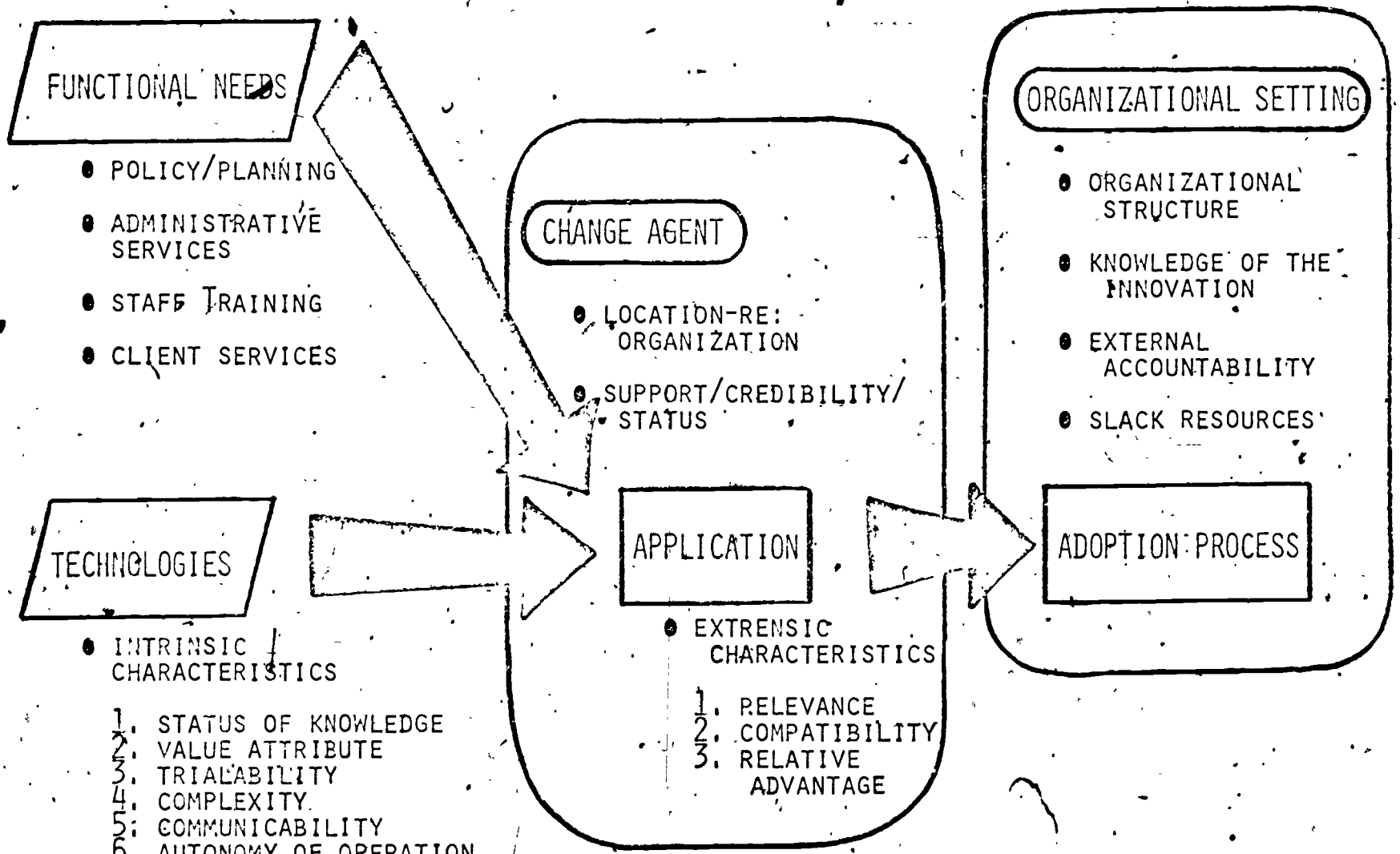

FIGURE 1

sources as Rogers and Shoemaker (1971), Havelock (1971), Lin and Zaltman (1973), and HIRI (1976), previous literature has identified that certain needs, technologies and applications with certain characteristics, certain types of change agents, and settings with certain organization qualities are more conducive for the adoption of innovation than others. For example, innovations involving client-related practices are more associated with successful adoption than are changes in intraorganizational processes (Yin et al., 1976). Innovations thrive in organizations characterized by high diversity, staff participation, external accountability, and slack resources, and low centralization and formalization. Since this paper deals with the barriers to the adoption of telecommunications technologies, emphasis will be placed upon the techological and application elements of the model.

TECHNOLOGY. Inherent within each technology are specific characteristics which have been found to be related to the degree of innovation adoption. The characteristics on which this analysis will focus includes (1) status of knowledge and engineering, (2) value attributes, (3) trialability, (4) complexity, (5) communicability, (6) regulation, and (7) autonomy of operation. The evaluation of a technology along these dimensions is based on the subjective perceptions of the potential adopters, which serve as their "reality" for decision-making. In a study of six new products, Ostlund (1969) found that the perceptions of a product's attributes predicted

innovativeness to a greater degree than all of the predispositional variables, e.g., venturesomeness, social integration, cosmopolitianism, and demographic and socio-economic variables. These dimensions are defined as:

1. Status of knowledge and engineering -- the perception of potential adopters to the state of the art of the technology in terms of reliability, durability, precision, size, and cost. Potential adopters are hestitant to invest resources in technologies that are still in a developmental stage. In a study of technology transfer, the Denver Research Institute (1970) observed that potential adopters displayed greater interest in the more mature technologies than in the relatively new technologies.

2. Value attribute -- the attitude of potential adopters to the technology regardless of application. Individuals possess stereotypical attitudes regarding technologies, such as the public's general fear of computers. In a study of attitudes (Kirscht and Knutson, 1961), individual's opinions regarding flouridation were found to be related to their attitudes towards science. Attitude towards particular innovations are established within the boundaries of more general frames of reference, such as technology and science.

3. Trialability -- the ability to incrementally increase committment to an innovation or return to the status quo with little difficulty. A gradual progression through the adoption

process permits the minimization of risks within a situation of uncertainty; a concern of prime importance to early adopters of an innovation. This variable combines the concepts of the more traditional terms of "reversibility" and "divisibility", which are related. In a variety of contexts, innovations that allow trial on a limited basis were more readily diffused and adopted (Ryan, 1948; Polgar, 1963; Mansfield, 1961, Katz, 1962; and Lippitt and Havelock, 1968).

4. Complexity -- the number of components of the technology, the behaviors and skills necessary to be learned for its successful operation, and the procedures required for effective maintenance. It has generally been found that complexity is inversely related to adoption. Fliegel and Kivlin (1966) have found negative correlations between complexity and adoption of farm innovations, while Utterback (1974) found similar results regarding industrial innovations.

5. Communicability -- the ability of potential users to observe demonstrations of the technology and the visibility of the results. Technologies that allow potential users to gain personal experience with the application are more likely to be adopted, since risks associated with the innovation can be reduced. This has been supported by Glaser and Ross (1971) within the context of social service programs and Czepial (1972) within the steel industry. Moreover, Feller (1974) found that decision makers prefer innovations with high visibility.

6. Autonomy of operation -- the ability of a single organizational unit to operate the technology. As a result of the problems encountered when organizations share resources, adopters would more likely prefer those innovations in which their unit maintains operational control. This variable is similar to the concept of pervasiveness of the innovation, or the degree to which implementation of an innovation requires adjustments in other organizational units. Both Menzel (1960) and Barnett (1953) point out that the involvement of other units tends to act as a negative force in the adoption of innovation.

7. Regulation -- the degree by which operational constraints may be imposed by governmental, consumer, and industrial groups. This variable has rarely been discussed in the innovation literature because most innovations are not subject to such restrictions. It is hypothesized that adoption would be less likely in those situations in which potential users perceive the possibility of "red-tape".

APPLICATION. The matching of a function with a technology creates the innovative application, and characteristics associated with such an application have been shown to influence the innovation process. These factors include (1) relevance, (2) compatibility, and (3) relative advantage. Similar to the intrinsic characteristics of the technology, adoption is most affected by the subjective views of potential users of applications. These dimensions may be defined as follows:

1. Relevance -- the degree to which the application fulfills a need. Adoption is most likely to occur if potential users perceive the application as alleviating some problem or "performance gap". Holloman (1966) commented that "most technological change, most innovation, most invention and most diffusion of technology are stimulated by demand." In their study of 567 innovations, Myers and Marquis (1969) found that 75% of the successful innovations were initiated as a direct response to recognized need due to market or production factors, 45% as related to market needs, and 30% as prompted by manufacturing needs. Only 21% of the cases were stimulated by the recognition of technical opportunity.

2. Compatibility -- the degree to which the application is consistent with existing values and past experiences. Material innovations, e.g. tools, are more easily adopted than non-material innovations, e.g. processes or ideas (Barnett, 1953). Thio (1971) views this concept as the "goodness of fit" with the adopter's characteristics. In, regard to the transfer of NASA technology, Wright (1969) commented that "there was almost 8 times as much interest motivated by the possibility of existing product or process improvement than was motivated by the change of acquiring completely new processes and products."

3. Relative advantage -- the benefits to cost ratio derived from the utilization of the application as compared to other alternatives. Innovations which are perceived to be more

advantageous than existing practices, or alternative courses of action, will be more readily adopted. Benefits and costs may be financial or psychological in nature, occurring on a short-term and long-term basis. Tulley (1964) commented that farm innovation decisions were substantially influenced by perceived relative advantage, while Coe and Barnhill (1967) described the failure of a new medical process as being the staff's perception that the improvements in efficiency did not surpass the costs of the changeover.

Some Preliminary Findings

At the mid-point of our research, we can speculate about the future of telecommunications technology for the delivery of human services. Figure 2 summarizes our initial review of telecommunications technologies, with the shaded areas indicating hypothesized barriers.

This preliminary analysis finds that radio, intrinsically, has the least number of barriers, and our review of applications has shown that radio is also very much underutilized. Similarly, the telephone is almost barrier free, with the knowledge and value attribute barriers reflecting limited knowledge of innovative uses, such as teleconferencing and tele-class.

While the wide-band, two-way capacity of cable television (CATV) has lead to great speculation of its potential,

Summary

Technology Barriers

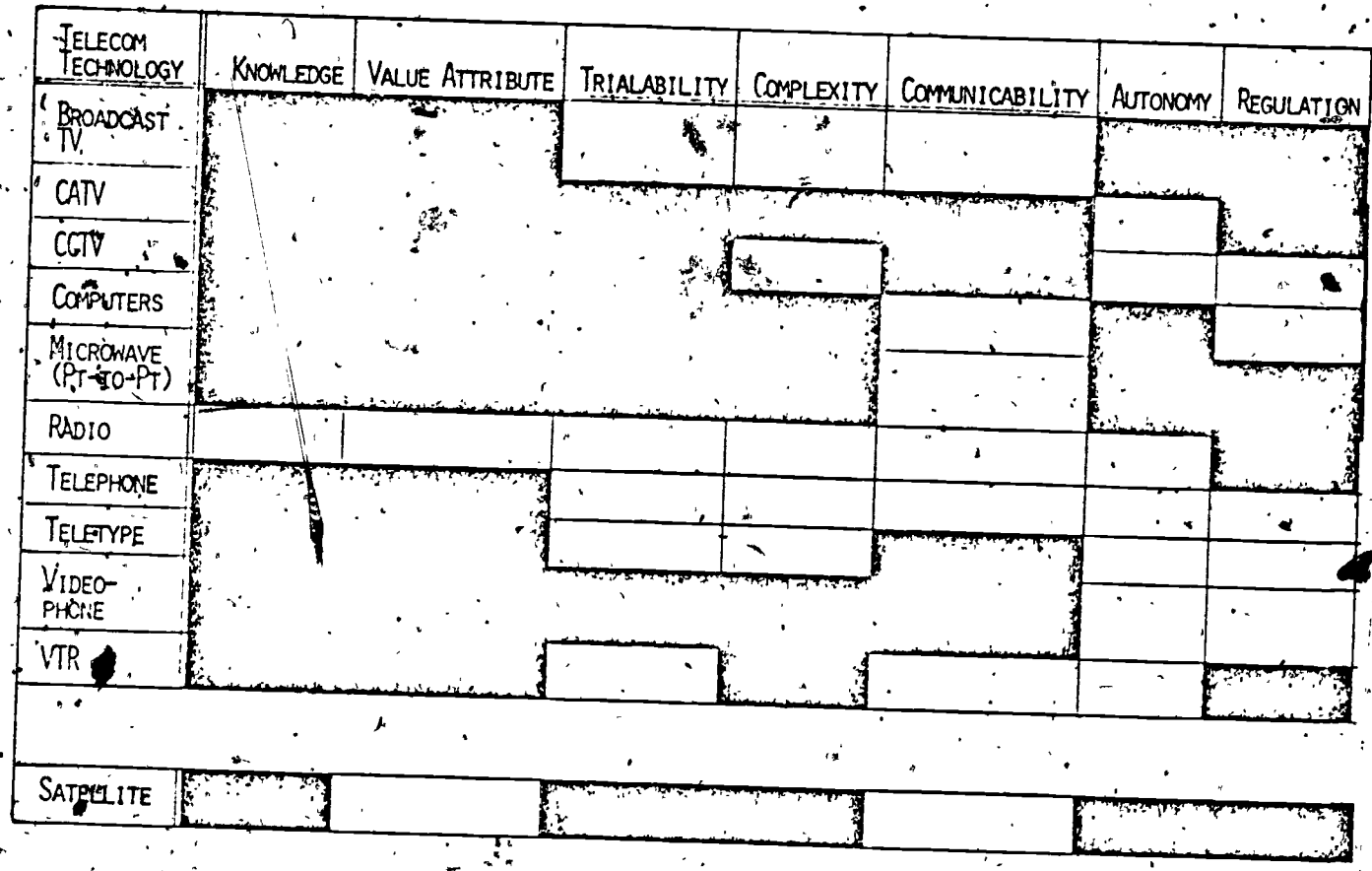

FIGURE 2

there are many barriers to its utilization. Besides the technical problems of providing interactive services, cable systems are not uniformly distributed throughout the country and tend not to be located in those areas with a pronounced need for social services. Moreover, a cable system can not be partially utilized, since two-way communications requires the installation and maintenance of all amplifers between terminal locations. Much the same may be said of specialized common carrier point-to-point microwave; all the towers and necessary repeaters must be in place.

Time, itself, is a major barrier. Much of today's telecommunications technology has been more or less generally available during the past twenty years. Yet, the perception of how this technology can be used, other than for the more obvious services, such as entertainment and personal/business telephone, is rather limited. Dwyer (1970) comments that doctors' knowledge and attitudes towards interactive television are limited to the passive and "inept programming model" of ordinary television. In part this limitation was due to the communication industry structure.

Broadcasting is an entertainment-based market, with very little support for the non-entertainment uses of broadcasting, while the common carriers have limited competition and, therefore, offer limited market push. Thus, specialized small audience broadcasting could not develop because of the high value and cost of the broadcast channels, but with the advent of cable and other distribution modes channels, the cost of channel

access can be reduced. The public and the professionals, however, still retain a mind-set that television is a mass entertainment medium, and this attitudinal barriers must be overcome.

As for the telephone, it is considered a device limited to one-to-one conversations. Because of these limitations, many of the potential innovations possible have only recently been introduced. Due in part to the rising cost of transportation, teleconferencing is now becoming somewhat more widely used by agencies delivering human services. As a result, many of the technical deficiencies that exist in most teleconferencing networks are becoming known and regulatory authorities are being pressured to overcome them.

Cable television, to be successfully used, requires a high penetration, i.e., subscribers per cable mile, of social service clients.

In time, penetration will increase as cable covers more of the urban centers in the country.

Similarly, as satellites are adopted by commercial users, terminals will be more widely distributed. The combination of broadband networks either via cable or optical fibers and satellites will make low-cost channels available to more communities and consequently to more clients needing services delivered to their homes.

Time is on the side of the telecommunications technologies, just as time is on the side of any new

innovation. In time, the telecommunications infrastructure will be more widely distributed and therefore more accessible to more people, hence to more potential clients of special human service delivery needs. Furthermore, expansion of market demand will lead to increased investment in technological development, resulting not only in higher quality, but also in lower costs.

Cost and the need to aggregate demand is a significant barrier, limiting autonomy of operations. The high cost of telecommunications services requires the aggregating of service demands among several agencies so that each can pay a smaller share of the total cost. In the United States, this creates administrative problems of severe magnitude. However, current communications policy trends point to a lowering of the costs of many communications services, which may reduce the need for aggregating demand for services and making it more likely that individual agencies can maintain their autonomy and purchase the required services themeselves.

With the lowering of some communications costs, the barrier of trialability might very well be reduced. With lower costs, the investment to innovate can be decreased, thereby offering the opportunity to incrementally increase commitment to the innovation or even return to a status quo with little difficulty and less financial risk.

Telecommunications allows for the bridging of the many hierarcharical levels in a human service delivery agency, and

therein lies the seeds of many barriers to adoption. Bridging these levels often alters the manner in which services are delivered, rather than the tools used to deliver these services. New tools are more readily accepted than are new practices. Thus, the physician will adopt a new drug rather quickly, but will have great difficulty delivering services on a two-way communication channel with the assistance of a para-medic or nurse. Moreover, increased communications are sometimes viewed as threatening, in that it implies peer review, e.g., a doctor watching another examining a patient, or reduces the autonomy of the practitioner.

This compatibility problem may be overcome by orienting practitioners to a "new" set of rewards, which would encourage the use of telecommunications. "In order for individuals to sustain their interaction in a meaningful and effective way, they must feel that their demeanor -- that which they value about the self -- is going to be protected and enhanced by their interaction" (Goffman, 1956).

At present, the delivery of telemedicine services is hindered by billing and payment difficulties. Payment procedures do not provide for the tele-service alternatives, only the tradional in-office or in-home visit by a physician are allowed. But the trend towards universal health service -- insurance and national health programs -- will very likely require the cost savings that telecommunications can offer, which will overcome these accounting barriers.

Regulation can be a significant barrier to adoption. There is a trend towards less regulation in all aspects of American life, and the degree to which this regulation is decreased will reduce the operational constraints on the adoption of new communications services that may be imposed by governmental agencies. In short, one might look forward to less red tape overcoming what today is a significant barrier to adoption.

Still, another barrier is the complexity of telecommunications technology. By complexity, it is meant the extent to which the operation of the technology, its maintenance, and its cost appears out of line with that the user's expectations of a new tool. This complexity is in large measure the consequence of the demand for specialized, often one of a kind, applications. As long as the technology lends itself solely to one of a kind applications, this barrier will persist. But as commercial applications of innovative communications services grow, as network or distributed information continue to replace the often expensive and complex stand alone systems, one can look forward to a reduction of costs and, indeed, of complexity.

Furthermore, in the minds of many, these complex systems will soon appear less so. Consumers will be increasingly aware of innovative communication technologies as they play video games, purchase pay TV movies over the cable, do their banking and purchasing remotely via electronic funds transfer terminal

attached to their telephones and utilize microprocessors in their homes. The consumer who may be a manager of a human services delivery operation, a staff member or a client, will become more aware of the computer/communications technologies and, consequently, will be less likely to raise attitudinal barriers towards these technologies in their work.

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